FORT ST. VRAIN NUCLEAR GENERATING STATION

DOCKET NO. 50-267

ADDITIONAL INFORMATION REGARDING

APPLICANT'S ECOLOGICAL STUDY

May, 1972

It is the purpose of this information to report progress on Applicant's continuing ecological study for the Fort St. Vrain Nuclear Generating Station. The information being submitted herewith consists of a report by the Thorne Ecological Institute entitled "Plan for Continuing Ecological Studies of the Fort St. Vrain Nuclear Power Plant, Site and Vicinity." This report presents a discussion of details of the ecological study plan, and includes a report of certain field investigations.

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PLAN FOR
CONTINUING ECOLOGICAL STUDIES
OF THE
FT. ST. VRAIN NUCLEAR POWER PLANT

SITE AND VICINITY

May 1972

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PLAN FOR INVESTIGATIONS OF ECOSYSTEMS OF THE FT. ST. VRAIN NUCLEAR GENERATING STATION

I. Introduction:

The environmental radiation surveillance program for the Ft. St. Vrain Station which was developed and is being conducted by Colorado State University is discussed in Section 5-6, of Applicant's Environmental Report, Operating License Stage. The program was based on a study begun in July, 1967, and collection of samples commenced during 1969. The purpose of the initial program was to establish routine surveillance of radiation in the environment before and following plant operation.

A supplemental program was instituted during 1970 to include sampling for aquatic biota. A discussion of this program is also set forth in Section 5-6 of Applicant's Environmental Report. The program at this time provides for sampling of aquatic biota at six locations: stations above and below the outfall from the plant in both the South Platte River and St. Vrain Creek, a station below the confluence of the streams, and a station in the farm pond on the north part of the Site. (see map in Appendix)

As a result of the environmental review of the project conducted by investigators from the Oak Ridge National Laboratory in December, the Applicant was requested to develop a plan for the continuation of the ecological studies of the Ft. St. Vrain Station Site and environs. A letter to the Applicant from the Division of Reactor Licensing dated February 17, 1972, requested that a comprehensive plan be submitted, including a statement of scope, range, biota, and time schedule.

Representatives of Applicant's management and the Thorne Ecological Institute of Boulder, Colorado, met with representatives of the Atomic Energy Commission environmental study team at Oak Ridge National Laboratory on February 22, 1972, to discuss the request for the plan for the continuation of the study.

Subsequently, the Applicant's management met with representatives of Thorne Ecological Institute (TEI) and Colorado State University (CSU) on March 2, 1972. As a result of this meeting, the following three phase program for the continuation of Applicant's ecological study was developed:

Phase I - Study design and ecological reconnaissances; March 1 - May 1, 1972

Phase II - Ecological inventory and analyses and design of supplementary Guide Level 3 monitoring system; May 1, 1972 - May, 1973.

Phase III- Supplementary monitoring program through first year of operation of the plant, and subsequent thereto as indicated by results of Phases II and III.

II. Description of Study Phases:

Each of these three phases is designed to provide a certain flexibility, so that research plans can be modified where needed to incorporate the most current information and understanding of the study team. Reports will be made of information and conclusions reached within each subphase.

A. Description of Phase I:

Design of continuing study and ecological reconnaissance (March 1 - May 1, 1972)

Highly qualified investigators were contacted concerning the design of Phases II and III (see Section IV for Study Team). They held group meetings with TEI professional staff to discuss the objectives, philosphy, scope, and techniques of the three-phase study. Each investigator visited the site several times during this phase to familiarize himself with the various ecosystems, their relationships to each other, to the nuclear plant, and to the surrounding human communities and ecosystems. They initiated literature search on related investigations. The field observations made during this period are submitted in Appendix A of this report.

The investigators prepared individual study plans covering the scope, range, biota, methods, and materials to be used, theoretical bases for these methods, related research, and time schedule for accomplishment of research. These plans were discussed with, reviewed and modified by TEI staff.

B. Description of Phase II:

Intensive dynamic base line inventory (May 1, 1972 - May 1, 1973)

This phase will produce a dynamic base line inventory of what organisms, environment factors, and ecological processes are operating at and around the Ft. St. Vrain Nuclear Plant Site. Phase II started May 1, 1972 and ends May 1, 1973. It is divided into two subphases: pre-operational and post-operational. The pre-operational subphase will be primarily intensive field data gathering during the growing season. It will provide base line data for comparisons to be made during the monitoring. The second subphase will commence with plant start-up and end May 1, 1973; it will overlap part of the monitoring of Phase III.

During Phase II, investigators will have meetings to exchange information. Sub-groups comprising the closely related fields will have additional meetings and field trips. These interactions will foster the ecosystem approach to the base line investigations. During the early part of Phase II, reports on previous site studies will be reviewed and a thorough literature search accomplished, preparatory to designing the initial monitoring program.

A detailed design and specific plan for the initial monitoring program will be evolved during this phase.

C. Description of Phase III:

Initial Guide Level 3 monitoring program (date of plant start-up to one year later).

Each investigator of each component described in Section IV has made a preliminary design of a monitoring program for the features of the ecosystems of the Ft. St. Vrain Site and vicinity for which he is responsible. During the summer of 1972, these investigators will be making a thorough literature search, together with intensive base line field investigations. At the end of summer, each researcher will present a refined plan for Guide Level 3 monitoring to be done during the first year of plant operation. This plan will include schedules for sampling, features to be observed and sampled, and analyses to be made.

The monitoring phase will be designed to compare the biota and ecological processes described in Phase II to what is occurring on and near the Site during Phase III. Investigations conducted during Phase II will determine the intensity, design and plan for the first year of monitoring. This year commences with start-up of the plant.

During this monitoring program, it will be determined what features should be monitored beyond the first year and in what intensity. It will also include tentative recommendations as to the duration of Guide Level 3 and the types of features to be monitored in Guide Levels 2 and 1 and for what time span.

III. A. Philosophic approach for the continuing study:

In order to reach scientific conclusions about the "environmental impact" of the Nuclear Plant, information on the nature and distribution of organisms and the description of ecosystem dynamics on and near the Ft. St. Vrain Nuclear Plant Site must have been gathered previous to start-up and operation, in order to have valid base line data for comparison with these features during operation. There are a few extant ecosystem studies that apply to the general type of the terrestrial ecosystems, but none have been done on the Site. For this reason, base line data gathering must establish what organisms are living on the Site and how many there are. Field investigations must determine the interactions operating among the various organisms within the ecosystems, what the major food webs are, what the major chemical pathways are. Where these relationships have been previously worked out by investigations on identical species, this information can be applied directly, with appropriate fieldchecks to determine what variations might be operating on the Site. Where such major studies have not been done elsewhere, they can be conducted on as part of this continuing program.

The base line data will form the vital reference points for comparisons made during the monitoring phase. The fact that many other variables are operating in the ecosystems on the site and in the vicinity that may produce changes independent of the plant operation must be incorporated into the research of the inventory and in the monitoring program. Variables include existing water and air pollution, agricultural management, pesticide control programs, and climatic flucuations.

Inventory investigations are designed to provide representative information on all major groups of organisms occupying or utilizing the Site. Some sampling may duplicate research conducted elsewhere. This duplication is done for the reason that it is thought important to sample key organisms on the site before and after operation so as to have definitive first-hand data on what is present and operating at Ft. St. Vrain.

Organisms integrate the composite of the environmental factors with which they live. Therefore, they are sensitive, accurate indicators of change in single factors or composite change in environment factors. Analysis of species diversity, structure of vegetation, population fluctuations, and individual vitality can assist in identifying alterations in environment factors.

B. Overall objectives of the continuing study:

It is the primary objective of the continuing study to document what environmental impacts the operation of the Ft. St. Vrain Nuclear Plant has on the species and ecosystems of the Site and its vicinity, including man. In order to accomplish this broad objective, it is necessary to record what

species and ecosystems are now present and, what processes are operating on the site.

1. Identify and map the various ecosystems on and in the vicinity of the Ft. St. Vrain Nuclear Power Plant Site.

2. Determine what organisms occur on and adjacent to the Site and what their distribution, vitality, numbers, densities, and fluctuations are.

3. Describe food habits for some key species and the food webs involving these species.

4. Describe and analyze organisms and communities on permanent sampling plots and observation areas.

5. Analyze key plants and amimals living in close proximity to the Slough, the Goosequill Ditch, and the Farm Pond for radioactivity for selected toxic substances. This would include key species in the food webs of these species.

6. Identify rare and endangered species utilizing the Site, the numbers present, their distribution, their ecological roles, and food habits.

7. Design a meaningful Guide Level 3 monitoring program for the first year of operation and subsequent years as may be needed.

IV. Description of Study Components for Base Line Inventory

Project Director: Dr. Beatrice E. Willard, Ecologist and President, Thorne Ecological Institute, Boulder, Colorado

Assistant Director: Mr. Hubert Burke, Forester and Research Administrator, Ft. Collins, Co-orado (formerly with U. S. Forest Service Research Division)

Study Team:

Aquatic ecosystems task force:

Algae - Dr. Paul Kugrens, Assistant Professor, Department of Botany and Plant Pathology, Colorado State University, Ft. Collins

Macro invertebrates - Dr. Clarence A. Carlson, Associate Professor of Fisheries, Department of Fishery and Wildlife Biology, Colorado State University, Ft. Collins

Artificial substrates - Dr. William McConnell, Director, Colorado Cooperative Fisheries Unit, Colorado State University, Ft. Collins

Fisheries - Dr. W. Harry Everhart, Professor of Fisheries, Department of Fishery and Wildlife Biology, Colorado State University, Ft. Collins

Vegetation task force:

Communities - Dr. Charles Bonham, Assistant Professor of Quantitative Ecology, Department of Range Management, Colorado State University, Ft. Collins

Plant species - Dr. Wallace M. Johnson, Range ecologist and taxonomist, Ft. Collins (Former U. S. Forest Service Research ecologist)

Ecophysiology - Dr. Joseph Trlica, Assistant Professor of Ecophysiology, Department of Range Management, Colorado State University, Ft.Collins

Terrestrial animals task force:

Invertebrates - Dr. J. Wayne Brewer, Associate Professor, Department of Entomology, Colorado State University, Ft. Collins

Birds - Dr. Ronald A. Ryder, Professor of Wildlife Biology, Department of Fishery and Wildlife Biology, Colorado State University, Ft.Collins

Mammals, Amphibians and Reptiles - Drs. Philip M. Lehner and Bruce Wunder, Assistant Professors, Department of Zoology, Colorado State Univeristy, Ft. Collins

Description of Biological studies:

A. Aquatic Ecosystems

The work described below is an augmentation of investigations of aquatic ecosystems that have been underway on the Ft. St. Vrain site for nearly two years.

1. ALGAE: Paul Kugrens, Assistant Professor, Department of Botany and Plant Pathology, Colorado State University

Phycological studies in the vicinity of the St. Vrain Nuclear Power Generator will consist of two separate but interrelated investigations that are to be conducted before and after the generator becomes operational. One will be concerned with field observations and experimentation, whereas the second will be laboratory oriented to substantiate field data and lend scientific validity to our observations on algae. Algae are important in the overall study since they are the primary producers and are sensitive to minor changes in their environment. Therefore algae could be used as bioassay organisms for a variety of conditions.

a) Objectives and methods

Field studies will deal with collection, identification, description of community types, heavy metal concentrations, and primary productivity of the algae throughout the year. Not only the kinds of algae present will be determined, but also seasonal fluctuations and successions. Explanations for population fluctuations will be attempted through chemical analyses of the water to monitor any changes in nutrient levels. Dissolved oxygen levels, turbidity and pH changes will also be monitored. Large fluctuations in any of these may be reflected in certain algal blooms, thus a tentative list of indicator algae may be possible for specific conditions in the rivers.

Laboratory studies will be aimed at correlating field data and predicting changes in algal populations under a variety of conditions. Initially isolations of the dominant algae will be made with subsequent culturing under controlled conditions, either in axenic or unialgal cultures. This is necessary for proper identification of many of the algae at the species level. Defined media will be used in nutritional studies to test specific requirements of these algae and the effects a single nutrient has on algal growth. The "test nutrients" will be those that are found at high levels during various times of the year in the South Platte and St. Vrain Rivers. A definitive indicator species list could be the result of this portion of the study.

b) Special studies:

Various heavy metals apparently might be discharged into the waterways after the power plant becomes operational. Although the metals will occur in low concentrations, it is a well known fact that algae are highly efficient in concentrating heavy metals, a characteristic that varies from species to species. Representative heavy metals, at various concentrations, may be added to unialgal or mixed cultures and intracellular accumulations measured after a period of time. This would allow some predictability on the consequences, if any, to be expected after the metals are actually discharged into the river. This could have broad implications as far as the food chains -- aquatic and terrestrial -- are concerned.

Finally, a chemical known as NALCO-345 will be used as a biocide to prevent clogging of pipelines in the cooling towers. This organic phospate will also be discharged into the river and presumably is unavailable to algae. It is advertised as being biodegradable, consequently the phosphate residues may be available to algae, and have undesirable effects on community organization. Similar techniques to those discussed for the heavy metals will be utilized to test the effects of the three NALCO chemicals on algal populations.

2. INVERTEBRATES AND FISH FOOD HABITS: Clarence A. Carlson, Associate Professor of Fisheries, Department of Fishery and Wildlife Biology, Colorado State University

The South Platte and St. Vrain Ri. s, which pass the Fort St. Vrain Nuclear Power Station and are expected to receive certain effluents from the station after operations commence, support limited populations of macroinvertebrate animals other than insects. Such groups as tubificid worms (Oligochaeta), snails (Gastropoda), scuds, and crayfish (Crustacea) are represented.

a) Objectives and methods:

Diversity of macroinvertebrates will be studied in the streams before and after the station begins its operation. Organisms will be collected (as water levels permit) with aquatic nets, Surber square-foot samplers, and an Ekman dredge. Sampling will be designed to collect, by a standardized procedure, invertebrates typical of the diverse habitats at each of five previously-established stream sampling stations and at one new station upstream from the intakes on the South Platte River. Organisms collected will be preserved at the study area and returned to the laboratory for identification. The zoological literature and limited studies of gut contents will be used to ascertain the role of each organism in the food web. Macroinvertebrates of Goosequill Pond will similarly be collected (primarily by an Ekman dredge), preserved, identified, and their role determined.

b) Studies:

Routine analyses of water chemistry will accompany collections on each sampling date. Natural stream and pond substrates will be analyzed periodically. Samples of macroinvertebrate types will be analyzed periodically for heavy metals and radioactivity. Bacteriological analysis of stream water will be conducted periodically.

Stomachs collected from fishes in the streams and Goosequill Pond will be analyzed to determine the extent to which various organisms (of all taxonomic groups) are utilized by various fishes as food. Representatives of all size groups of fishes from all available habitats at the sampling stations will be selected for stomach analysis. Combinations of volumetric, numerical, and frequency of occurence methods of stomach contents analysis will be used.

This work will necessitate close cooperation between all members of the aquatic inventory team. Together, the team's efforts are expected to elucidate the food web in the aquatic environment in the study area and provide a basis for understanding other ecological relationships near the Ft. St. Vrain Nuclear Power Station.

3. ARTIFICIAL SUBSTRATE MONITORING: William McConnell, Director, Colorado Cooperative Fisheries Unit, Colorado State University

This phase of the ecological evolution will be directed toward location of changes in the plant and animal community colonizing artificial substrata (attachment or hiding devices). These will be placed upstream or downstream of power plant discharge points in both the St. Vrain and Platte Rivers. Analysis of communities living in or on identical artificial substrate units will provide information that will complement that obtained from sampling of the natural stream bottom materials. Sample variability is reduced by using artificial devices, which should improve monitoring sensitivity. Communities of the natural substrata are more representative of the natural environment, however. The artificial devices divorce the negative effects of shifting stream sediments not related to generating plant operation from water quality changes which may be caused by plant discharges. The artificial devices are also more amenable to continued monitoring past the initial years of plant operation.

a) Methods:

Habitat units for detection of changes in the invertebrate community will consist of wire baskets containing uniformly sorted gravel. Algal growth occurring in glass slides will be analyzed for species diversity, biomass and chlorophyll content. Devices will be placed at uniform depths in the main stream channel. Analysis will consist of census of the communities developed during periods of 5 to 8 weeks. At least 3 kinds of diversity indexes will be calculated to determine the most sensitive index for continued monitoring.

4. FISHES: W. Harry Everhart, Professor of Fisheries, Department of Fishery and Wildlife Biology, Colorado State University

The biological inventory of the biota in the vicinity of the St. Vrain Nuclear Power Station will be structured around the food web with the fish as the final consumer. Species present, distribution (including seasonal variations), information about the population dynamics, and food habits will be investigated.

a) Methods:

Electrofishing is an efficient way to collect fish, although there are definite limitations when water levels are high. Fish sampling will, of necessity, be dependent on water flows. All possible fish habitats will be sampled to ensure, as nearly as possible, that all the different kinds of fish are collected. This information is basic in determining community diversity indexes before and after plant operation. Population estimations are not considered practical in this study, but comparable sampling sections should provide an index of abundance from one sampling period to another.

Lengths, weights and scale samples will be obtained to provide information on the age and growth of the fish for later comparisons. Changes in the age structure of the fish populations and in the growth could be of value in measuring future impact of habitat changes in the St. Vrain and South Platte Rivers.

Detailed analysis of the stomach contents of the most numerous fish species and from representative size groups will be made. Digestive tract contents, accompanied by ecological studies, can provide a base for resource management. Depending on the type of food eaten, we will use combinations of columetric, frequency of occurrence, and numerical methods of estimating stomach contents. Food habit information will be integrated with the information about the general biota. Future analysis of food habits can help to determine whether changes have occurred in the food organisms eaten or available to the fish.

B. Terrestrial Ecosystems

The work described herein are investigations commenced in March 1972.

1. MAMMALS, REPTILES, AMPHIBIANS: Drs. Philip N. Lehner and Bruce A. Wunder, Assistant Professors of Zoology, Colorado State University

a) Objectives and rationale

Intensive ecological investigations have been undertaken of the terrestrial communities in the region of the Ft. St. Vrain nuclear power plant. Detailed knowledge of the present extent of animal occupancy and use of the terrestrial communities and the structural and functional properties of the land communities are paramount to answering later questions concerning enhancement or disruption of ecosystems as a result of nuclear power development.

In order to piece together the structure and function of the terrestrial communities in the nuclear power plant vicinity, it is proposed to determine species presence and distributions. In order to understand function, it must know what animals are found there and where they occur. Further, it is important to estimate population densities of species, where practical. Density is an important parameter for it gives some insight into a species' possible importancein an ecosystem and changes in density may imply primary or secondary environmental changes. It would be preferable to have at least one year for the inventory, as seasons may have an important influence on density (low winter populations and high numbers in spring and summer). Time will not be available for an entire year of study before plant startup; therefore it will be necessary to identify those species for which we might expect seasonal density changes. It is critical that any future comparisons keep this time parameter in perspective, for only comparable seasons can be compared. In addition, seasonal studies may allow the investigators to identify those times of the year when the terrestrial communities are most fragile and the most care must be taken in effecting change.

From scientific knowledge of species presence, distribution, and density community diversity can be calculated. This is a critical parameter for diversity, and it indicates the resiliency which a community may have for change. Simple ecosystems are usually the most fragile and can be damaged by simple changes whereas complex, diverse communities may use alternate pathways, as changes occur. Changes in community diversity may be used to indicate environmental modification.

This study must, of necessity, be limited in scope. Investigations will be made to identify key indicator species, or endangered species

B. Terrestrial Ecosystems, continued

in the environment, which have a high probability of indicating any deleterious environmental changes. These species can then receive concentrated monitoring in a later phase of the project.

Since these studies of the terrestrial communities will form a basic comparison point against which to assess possible influence by the nuclear power plant, it is critical that a full understanding of the total ecosystem be obtained. Thus close coordination with investigators in charge of other sections of the study is mandatory and the information on community structure, stream fauna (as food sources for some of the terrestrial forms), air monitoring for contaminants, and weather information (particularly temperature and humidity regimes) will be utilized in formulating conclusions and recommendations. Only by knowing something of all these components can an intelligent interpretation of findings be achieved.

b) Methods

Sampling Design:

To meet the objectives, three or four different habitats will be delineated using aerial maps and ground surveys. Faunal community structure should vary with habitat type. It is also planned to investigate the effect of distance from the power plant by delineating two or three concentric zones around the plant and sampling habitats within each zone. In addition to these two spatial parameters, sampling will be conducted as a function of time. This temporal parameter can be gained by dividing the year into four seasons. Temporal sampling will reflect seasonal alterations in species diversity, density and distribution.

Mammal Sampling

Mammal species can be identified and inventoried by a variety of methods. Direct observations, secondary indicators (e.g. tracks, scat, gnawings, burrows, etc.) and trapping can be used to establish a species' presence and distribution. Species densities can only be approximated since it is extremely difficult to accurately measure absolute density in small mammal populations (French et al. 1971. Palmer, 1971). The International Biological Program has spent many dollars and much time testing various techniques and still has not settled on a single, accurate type. Good relative density indices for the small mammals can be obtained by using either standard trapping grids or North American Census of Small Mammal Lines (Calhoun, 1958). Live traps will be used since individuals will be marked and released for possible recapture. The following information will be recorded (when possible) for each

B. Terrestrial Ecosystems, continued

individual trapped: Identification number, species, sex, age, date, time and location. Recapture data provide estimates of species densities for small mammals (Jolley, 1965). Relative density indices for cottontail rabbits and larger mammals will be generated by using the King Line Transect Census Technique at dusk and by spotlight after dark.

Estimates of community diversity will be established by collating information gathered in the identification, inventory and density estimate procedures described above.

Reptile and Amphibian Sampling

Reptilian and amphibian species will be identified and inventoried by both diurnal and nocturnal searches of various macro- and microhabitats (e.g. under logs, catch basins, currows, foliage, etc.) and use of G-8 drift fence traps. Individuals will be captured using various techniques (e.g. nooses and nets; Stebbins, 1954). Most individuals will be marked and released; however, a few will be sacrificed to insure proper identification, provide limited information on food habits, and to obtain tissue samples for tissue analysis. Species densities will be estimated from marking -- recapture data gathered using G-8 drip can transects.

Data Analysis

Data will be transcribed from field notes and field forms to computer punch cards. Conclusions will be drawn only after careful application of appropriate statistical analyses. Several statistical tests will be conducted with the Colorado State University computer incorporating, where possible, systems analyses programs generated by the IBP Grasslands Biome program.

Chemical Analyses

A limited number of mammals, reptiles, amphibians and ivertebrates will be sacrificed for chemical analyses. Analyses of whole animals and selected animal tissues for environmental contaminants, such as heavy metals and pesticide compounds, will be conducted by reliable laboratories on a contract basis.

c. Schedule

It is envisioned that the inventory of mammals, reptiles, and amphibians as necessitating two phases, an initial intensive during-the-growing-season, later extensive phase to complete one year. The initial intensive inventory is of vital importance in providing baseline data prior to power plant activation.

B. Terrestrial Ecosystems, continued

d) Literature cited:

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French, N. et al. 1971. Comparison of some IBP population estimates methods for small mammals. Special Report, Office of the Chairman, USNC/IBP.

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Stebbins, Robert C. 1966. A Field Guide to Western Reptiles and Amphibians. Houghton-Mifflin Co., Boston.

Stebbins, Robert C. 1954. Amphibians and Reptiles of Western North America. McGraw-Hill Co. New York.

B. Terrestrial Ecosystems, continued

2. BIRDS: Ronald A. Ryder, Professor of Wildlife Biology, Department of Fishery and Wildlife Biology, Colorado State University

The principal reasons for the intensive inventory are to identify and study the avian populations and habitats and to establish routine censuses and surveys that can be conducted at regular intervals in subsequent years in order to evaluate the changes (if any) in avian species, numbers, their distribution and utilization of the different habitats on the sites.

a) Objectives

1. To identify habitats important to the birds utilizing the site.

2. To prepare, by means of original field studies and secondary analysis, annotated lists of the avifauna of these habitats showing:

   (i) common name
   (ii) scientific name
   (iii) status (nesting, migrant, permanent resident or only transient
   (iv) abundance, common, uncommon (occasional, rare)
   (v) periods of occurrence

3. To establish procedures for the repetitive enumeration of the various species of birds utilizing the site. Methods most likely will include standardized plot and roadside counts such as currently being conducted elsewhere in Colorado by the wildlife consultant for the U. S. Fish and Wildlife Service and the International Biological Program.

4. To gather information on nesting success and food habits of the dominant species of birds.

b) Plan of Studies

The principal investigator and/or a graduate student technician will make weekly visits to the site commencing April 15, 1972. They are establishing standard North American breeding bird survey plots in at least three dominant vegetative types. They are making early morning counts of birds until October 15. The remainder of 1972 and until April 14, 1973, monthly counts will be made of the same areas to document the wintering populations. Further communication is planned with the ecological, limnological and hydrological consultants.

B. Terrestrial Ecosystems, continued

3. INVERTEBRATES: J. W. Brewer, Associate Professor of Entomology, Colorado State University

The overall goal of this phase of the project is to determine the effect of the operation of the Ft. St. Vrain Nuclear Power Plant, and the environmental changes associated with its operation, on the terrestrial invertebrates in the area. The first problem then, is to learn what invertebrate species are present in the vicinity of the plant before it begins operation. After plant operation begins, changes in populations of these invertebrates must be monitored. It would be impossible within the time to monitor population fluctuations of all the terrestrial invertebrates present in this rather large and diverse area. Therefore, important species groups most likely to be influenced by the effects produced by the plant will be selected for detailed observation.

a) Objectives

1. To make an inventory of the important invertebrate (primarily insects and other arthropods) species in the vicinity of the Ft. St. Vrain Power Plant.

2. To determine the appropriate invertebrate species for the monitoring phase of the project.

3. To determine the ecological relationships existing within the selected areas for the monitoring phase and to establish how these relationships relate to the higher organisms studied by other researchers on the investigations team.

b) Methods

The inventory phase of the project will be conducted intensively during the spring and summer of 1972; an extensive phase will be undertaken through April 1973. Insects and related arthropods will be collected using various techniques and sampling devices. The sampling devices will include the Malaise aerial trap, the black light-type trap, the bait-type trap, and pitfall traps. The Malaise aerial trap is an effective sampling device for diural flying arthropods and is the standard for traps of its type. Sweep nets, aspirators and forceps are standard orthropod collecting devices and will be used whenver appropriate. Indirect sampling methods (presence of nests, damage, etc.) also provide means of estimating arthropod population that will be employed.

An ideal situation would be to locate several insect or other arthropod species common to the area that were reasonably stable in location and populations level from year to year. Then appropriate sampling methods could be established to follow population fluctuations of these organisms

B. Terrestrial Ecosystems, continued

throughout the monitoring phase of this study and thus to determine if activation of the power plant altered these populations. Some insects that might be appropriate for this part of the study would include grasshoppers, ants (especially harvester ants), spiders and isopods. The relative abundance and distribution of these organisms must be determined during the inventory phase, before deciding on the selection of the groups to be extensively sampled during the monitoring phase. A sampling program will involve establishment of the samplers early in May and servicing of the material every three days throughout the warm season. The various types of sampling devices used would give an excellent cross-section of species present in the area.

These specimens will be identified as accurately as possible and stored as voucher specimens for future reference. After the groups to be monitored are selected, continued sampling of those groups will be made by appropriate means throughout the monitoring period. Thus it can be determined if changes in populations of these invertebrates do occur.

c) Literature cited

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Hartsock, J. G., H. O. Deay, and J. R. Barrett. 1966. Practical application of insect attraction in the use of light traps. Bull. Entomol. Soc. Amer. 12:375-7

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Vegetation Characteristics and Composition

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An inventory of natural vegetation characteristics of the Ft. St. Vrain Nuclear Power Plant Site will be made.

a) Objectives:

1. Collection, identification and documentation of all plant species found growing on the property.

2. Identification and quantitative description of all natural vegetation types and crops.

3. Establishment of permanent observation plots in vegetation types.

4. Determination of chemical and radiation levels in key species before plant operation.

5. Estimation of response of plants to air pollutants and natural pests before plant operation.

6. Determination of key plants in key food webs.

b) Project Description:

The information stated in the objectives is needed to establish base line data against which to monitor changes that may occur in these ecosystems over time after plant startup. A quantitative description of plants and vegetation is necessary in order to establish and investigate changes induced by the nuclear reactor and by other causes.

The major types of natural vegetation at the Ft. St. Vrain Site will be described. These types will be characterized further by descriptions of the various strata of plants present, their cover-abundance and frequency. Cultivated crop data will be recorded and include: type, estimated yield, acreage planted, location with respect to the boundaries of the site, fertilizer and pesticide treatments.

The cooling towers will increase water vapor in the air and may significantly alter the microclimate of the area.

It is known that increased humidity interacts with air pollutants to cause damage to the photosynthetically active tissue of native and cultivated plants. Since The Ft. St. Vrain Site is in the Denver air pollution corridor, visual analysis of photosynthetically active tissue of selected species will be made at monthly intervals during the active growing season (April - September 1972). Indicator species will be determined after field studies provide a list of possibilities for later observation. Leaves and stems of vegetation will be visually examined for possible pollutant effects during the base line inventory period.

Radiation analyses of selected plants will establish base reference points

during the base line inventory phase of the study before the nuclear generator plant is in operation. These reference points will provide comparisons by which the monitoring program analyses can determine if the nuclear installation is having any effect on or producing radiation that is being concentrated by the vegetation. This information will be integrated with that developed by zoologists on food webs, to develop information on concentration by organisms higher on the food pyramid. Species for these analyses will be selected only after a thorough search is made of the literature to locate data that may already be useable for these comparisons.

Vegetation samples will be collected during peak growth periods along irrigation ditches and slough leading from the cooling towers, as well as near the edge of the rivers and farm pond, both up and downstream from the place of effluent entry into the river channels. Biomass will be determined on these samples. These vegetation samples also will be analyzed by gross Beta and Gamma scanning techniques to establish base load of radioactivity before start-up. They will also be analyzed for concentration of heavy metals that might be increased by the action of the cooling towers.

c) Methods:

It is proposed that permanent exclosures (1/2 acre in size) be constructed in representative communities of native riparian vegetation along the flood plains of the Ft. St. Vrain and South Platte Rivers to eliminate livestock grazing and for collection of biomass samples of vegetation. Exclosures will also be constructed in irrigated pastures of intermediate wheatgrass (Agropyron intermedium) on property owned by the Public Service Company. These exclosures will be located both up and down wind (for prevailing winds during the growing season of April - September) so as to determine if increased humidity interacts with air pollutants to cause damage to the photosynthetically active tissue.

Permanent plots will be marked both inside and outside exclosures so that repeated sampling can be done. The presence, abundance, and distribution of a species in combination with other species give a quantitative statement of vegetation types. This information will be obtained by locating a quadrat on the ground and determining all the species that are present, and their cover-abundance. The exact size of the quadrat will be determined during preliminary sampling. Since species presence and cover data can be obtained without disturbing the vegetation, future changes, if any, can be evaluated by sampling of the same plot over a period of time.

Taxonomic collections will be made in the major vegetation types and in exclosures. The entire site will be examined periodically to collect species not in the regular collecting areas. Collections will be made on two-week intervals, April through September to show species composition change with season.

Determinations of radiation load in biomass samples will be made by the same laboratory doing the on-going radiation monitoring.

Gamma scanning, gross Beta determinations, and Strontium - 90 will be analyzed, together with total fission products.

Field observations and aerial photographic methods ("remote sensing") will be used in combination to obtain a basic vegetation map. Black and white aerial photos will be used in vegetation mapping. Color infrared photos will be used to estimate vegetation vigor, for examples: (1) percent crown of trees that are dead; (2) seasonal variations of vigor.

Since riparian vegetation along the rivers may be related more directly to the possible immediate project impacts, a permanent record of individual tree characteristics will be made along the Saint Vrain and South Platte Rivers. Samples will be obtained of representive tree size classes to determine tree ages by core boring and counting growth rings. This record will be augmented by the aerial photos, which will enable the investigators to accurately locate the dead trees, determine proportion of tree crowns alive, count the number of trees, and evaluate the vigor of individual trees. These data are important to locate and distinguish possible tree deaths resulting from maturity, aging, and parasites, rather than from changes traceable to the plant operation.

Summary of the Vegetation Inventory:

The vegetation inventory will produce a vegetation type map of the Ft. St. Vrain Site. Each type will be described as to species composition, dominance, frequency, and cover-abundance. Interpretations of the developmental status of plant associations will be made. Natural environmental fluctuations expected and compared will be estimated to possible changes occuring as the result of man-induced environmental changes. Physiological information from the vegetation will be interpreted in view of current ongoing processes, including air pollution from other sources. The uptake of heavy metals, radiation, and other chemicals used on the site will be investigated.

APPENDIX

Data from Terrestrial Ecosystem Studies gathered to date:

A. Vegetation

B. Mammals, Reptiles, Amphibians

C. Birds

Data on Aquatic Ecosystems gathered in Phase I:

D. Aquatic Biota

A.

PRELIMINARY REPORT ON THE VEGETATION CHARACTERISTICS OF THE ST. VRAIN NUCLEAR POWER SITE

Charles D. Bonham

and

M. J. Trlica

April 25, 1972

A reconnaissance of vegetation of the St. Vrain Nuclear Power Site began on March 8, 1972. During the six-week period ending April 24, a total of 10 man-days was expended in studying the vegetation on the site, studying aerial photos (1967-supplied by Public Services Company), and in conferences with Dr. Willard of Thorne Ecological Institute. Since most of the vegetation was still dormant, no attempt was made to identify all individual species. However, it was possible to identify some general vegetation types based on the occurrence of various plant species. To date, four broad vegetation types have been identified and are described according to observed characteristics. Six major vegetation associations have been described. These are a first approximation and minor changes may be made later.

The numbers in parentheses are used to indicate a typical stand of the major types on the map in Figure 1.

I. River-associated Vegetation

As the name implies, the type tends to follow the two rivers flowing through the site. Sometimes this type is found to extend along the irrigation ditches and in floodplain areas. Two major subdivisions of this broad type have been identified.

A. Cottonwood Association (1) The cottonwood is the most conspicuous species in this association. The density of cottonwoods varies greatly from a relatively open to a completely closed canopy. The understory vegetation is complex, including shrubby species, grasses and annual and perennial forbs.

B. Willow Carr Association (2) Several species of yet unidentifiable willows are the dominant species in this association. This association occurs predominately on the edge of the rivers and commonly intergrades with adjacent upland and lowland plant communities. Sedges, rushes and grasses are also present in the willow carr association.

II. Lowland Vegetation

Areas supporting lowland vegetation are those covered during the growing season with shallow, slow-moving water. Two major associations have been assigned within this type.

A. Willow Carr Association. This is indistinguishable at present from the willow carr association described under River Associated Vegetation.

B. Cattail-Sedge Association (3) Cattails and sedges are the dominant species in this association. Rushes and grasses are also found to be common associates.

III. Upland Vegetation

This type occurs on areas which are not periodically or frequently covered with standing or flowing water. This type is extremely variable in vegetation composition and includes abandoned cropland, native pasture, irrigated past

(reseeded), and roadside and fence-row vegetation. Each of these associations are briefly described.

A. Abandoned Cropland (4) This vegetation type occurs in the immediate vicinity of the reactor site and at one time was under intensive cultivation. This type appears to be made up of primarily weedy species of old field succession.

B. Native Pasture (5) This vegetation association is being grazed by domestic livestock and consists of native grasses. Forbs are also an important component of this type.

C. Irrigated Pastures (6) The vegetation occurring in these areas are reseeded introduced grasses. These pastures are grazed by livestock.

D. Roadsides and Fence-Rows. These areas generally consist of weedy vegetation but some native plants are present.

IV. Cropland

This area is currently under cultivated agriculture and crops will be determined later.

Each of these types has been observed to consist of different vegetation species and in order to adequately sample each of the associations, it is planned to use fenced exclosures in each type. These exclosures will be used for all vegetation monitoring in the future.

Leaves and stems of vegetation are bein visually examined for possible pollutant effects now so that changes can be monitored after humidity increases in some areas on the site (i.e. cooling towers, ponds, and drainage canals). Visual analysis made on young leaves and stems of Kochia scoparia and Agropyron smithii plants on April 3, 1972 at the St. Vrain Site indicated no visual damage caused by air pollutants was evident at that time. Most other species had not yet initiated spring growth on the April 3 sampling date.

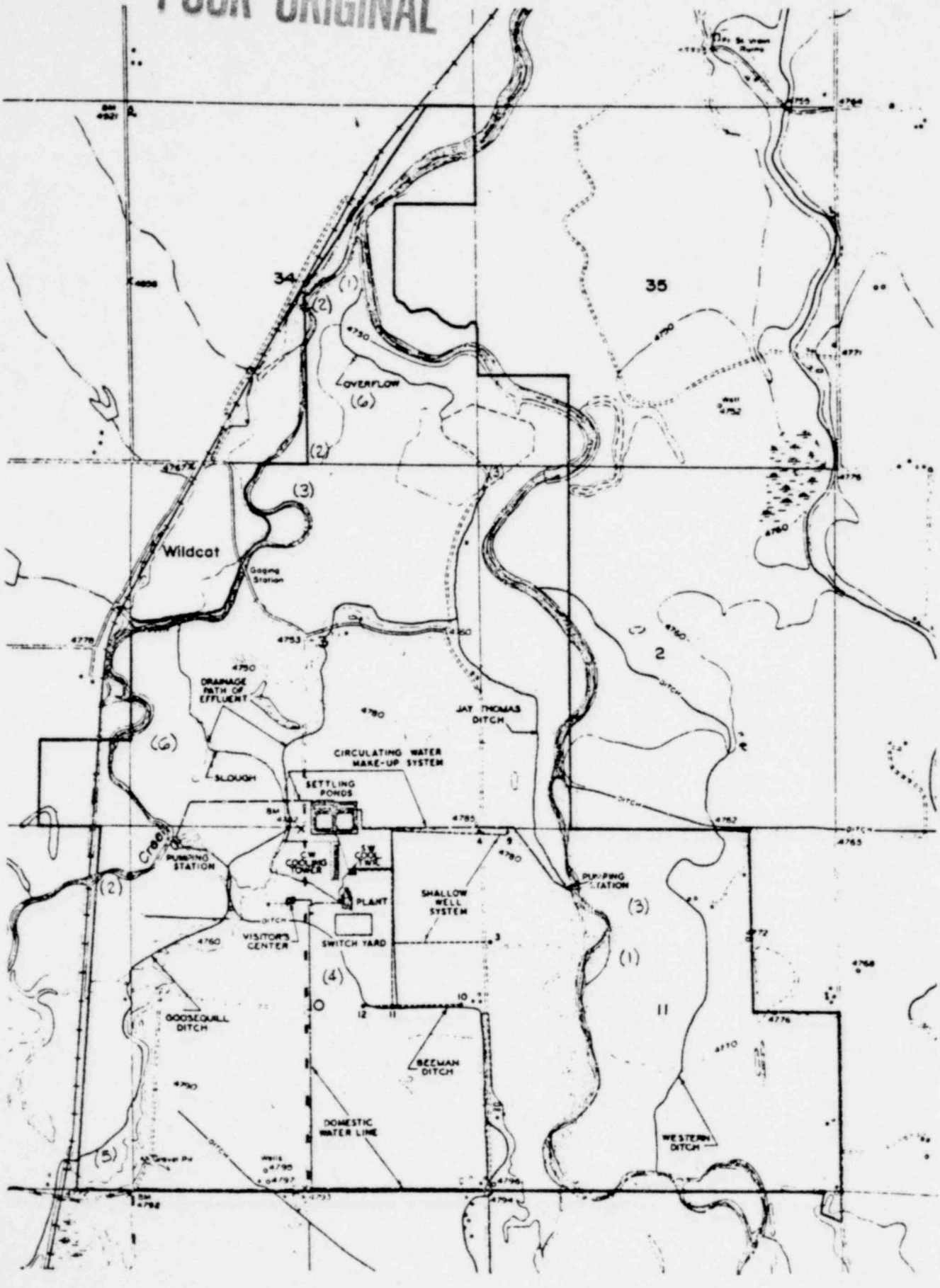

FIGURE A-1 - TYPICAL STANDS OF MAJOR VEGETATION TYPES

B.

PRELIMINARY SURVEY REPORT ON MAMMALS, REPTILES, AND AMPHIBIANS OF THE ST. VRAIN NUCLEAR POWER SITE

Dr. Philip N. Lehner

and

Dr. Bruce A. Wunder

April 25, 1972

The data presented in this informal report are the results of our initial cursory surveys, gathered on three preliminary site visits which included one trapping night and one spotlight survey. A list of mammals or mammal sign observed is presented in Table 1. There appears to be quite a diversity of mammals present in the various habitats surrounding the nuclear plant.

Although great numbers of voles were not trapped in the one trapping period, some were caught and the runways and tunnel systems indicate they may be present in fair numbers. Since they eat primarily vegetative plant parts, they should be a good monitor species for heavy metals, especially lead. Cottontail rabbits may do equally well. There is a good deal of raccoon sign and these animals could serve as an excellent biological amplification system for monitoring possible pollutants, as they are omnivorous and stand near the top of many food webs. However, they may be difficult to collect, and some numbers estimates are needed before disturbing this important trophic level.

Using these preliminary surveys as a basis, it is planned to establish permanent census grids and transect lines in order to establish density estimates. Census lines will be used in cultivated areas, as most of the mammals will probably be concentrated along the edges of fields and irrigation ditches.

Only two reptiles and one amphibian have been found to date (Table 2). The river bottoms, pond area and sloughs on the west side of the property provide ample habitat for a variety of species. Mean daily temperatures are still too low for much activity by either reptiles or amphibians. Activity should increase substantially in May. In anticipation of this activity, drop can transects will be located in preferred habitats. Spotlight searches for amphibians and diurnal searches in preferred habitats for reptiles will be continued.

Table 1

Mammals Seen in the Area of

The Fort Saint Vrain Nuclear Power Plant

April 25, 1972

	Cultivated Areas Open Pasture Lands	River Bottom Platte River	River Bottom St. Vrain River	Pond Area
Cottontail Rabbit[1]	sight	sight	--	--
Rock Squirrel	--	sight	--	--
Fox Squirrel	--	--	sight[2]	--
Beaver	--	--	cuttings & track	--
Harvest Mouse	trap	trap	--	--
Deer Mouse	trap	trap	--	trap
Prairie Vole	trap	trap	--	--
Muskrat	--	track & sight	track	track & sight
House Mouse	trap	--	--	--
Coyote or Dog	track	track	sight[2] & track	--
Raccoon	--	track & scat	track	track
Skunk [3]	smell	--	--	--
Deer	--	track & scat (old)	--	--

[1] Also seen on the power plant grounds

[2] Sighted by Dr. Ron Ryder

[3] Smelled near the farm north of the power plant

Table 2
Reptiles and Amphibians Seen in the Area of
The Fort Saint Vrain Nuclear Power Plant

	Cultivated Areas Open Pasture Lands	River Bottom Platte River	River Bottom St. Vrain River	Pond Area
Snapping Turtle	--	--	found dead [1]	--
Painted Turtle	--	--	--	found dead
Bullfrog	--	--	--	captured& released

[1] Found by Dr. Ron Ryder

Scientific Names of Mammals, Reptiles and Amphibians

Common Names:	Scientific Names:
Cottontail Rabbit	Sylvilagus sp.
Black-tailed Jackrabbit	Lepus californicus
Rock Squirrel	Spermophilus variegatus
Fox Squirrel	Sciurus niger
Beaver	Castor canadensis
Harvest Mouse	Reithrodontomys sp.
Deer Mouse	Peromyscus maniculatus
Prairie Vole	Microtus ochrogaster
Muskrat	Ondatra zibethicus
House Mouse	Mus musculus
Coyote	Canis latrans
Raccoon	Procyon lotor
Skunk*	
Deer*	
Snapping Turtle	Chelydra serpentina
Painted Turtle	Chrysemys picta
Bullfrog	Rana catesbiana

* Must await sighting for species confirmation

C.

PRELIMINARY SURVEY REPORT ON STUDY AREAS FOR BIRD COUNTS OF THE ST. VRAIN NUCLEAR POWER SITE

Ronald, Audrey and Helen Ryder

and

Mary Hill

April 8 - 16, 1972

STUDY AREAS FOR BIRD COUNTS

Species	Ponds	S. Platte R.		St. Vrain Cr.		Totals	
		Apr. 8	Apr.16	Apr. 8	Apr.16	Apr. 8	Apr.16
1. Great Blue Heron	4	2	12	1	-	3	16
2. Mallard	7	15	4	40	6	55	17
3. Gadwall	2	10	23	66	9	76	34
4. Pintail	2	-	-	-	-	-	2
5. Green-winged Teal	2	40	15	17	16	57	33
6. Shoveler	16	10	-	3	-	13	16
7. Red-tailed Hawk	-	-	-	1	-	1	2 1/
8. Sparrow Hawk	1	1	4	6	7	7	12
9. Ring-necked Pheasant	-	-	-	-	1	-	1
10. Killdeer	1	7	4	3	1	10	6
11. Common Snipe	-	1	2	-	-	1	2
12. Greater Yellowlegs	4	19	7	1	-	20	11
13. American Avocet	10	1	-	-	-	1	10
14. California Gull	8	1	-	-	-	1	8
15. Ring-billed Gull	300+50	8	-	-	-	8	300+50
16. Franklin's Gull	2	-	-	-	-	-	2
17. Rock Dove	-	4	-	-	3	4	3
18. Mourning Dove	-	2	2	2	5	4	7
19. Great Horned Owl	-	-	-	1	2	1	2
20. Belted Kingfisher	-	-	1	-	-	-	1
21. Red-shafted Flicker	2	8	15	2	12	10	29
22. Downy Woodpecker	-	-	-	-	1	-	1
23. Say's Phoebe	-	-	-	-	-	-	1 1/
24. Black-billed Magpie	-	6	3	1	2	7	5
25. Black-capped Chickadee	-	2	11	1	2	3	13
26. House Wren	-	-	1 2/	-	-	-	1 2/
27. Robin	-	3	7	-	3	3	10
28. Starling	-	21	48	-	36	21	84
29. House Sparrow	-	-	-	-	3	-	3
30. Western Meadowlark	1	6	3	2	16	8	20
31. Red-winged Blackbird	6	14	4	400	80	414	90
32. Brewer's Blackbird	-	-	-	-	2	-	2
33. Common Grackle	-	-	-	-	1	-	1
34. American Goldfinch	-	-	1 2/	-	-	-	1 2/
35. Tree Sparrow	-	-	-	-	2	-	2
36. White-crowned Sparrow	-	-	5	-	-	-	5
37. Song Sparrow	-	-	2	3	1	3	3
38. Oregon Junco	-	6	-	-	-	6	-
39. Pied-billed grebe	-	-	-	1	-	1	-
40. Semi-palinated plover	-	33	-	-	-	33	-
41. Unidentified passerine	-	1	-	-	-	1	-
42. Unidentified woodpecker	-	-	-	1	-	1	-
TOTALS	368	221	174	552	211	773	756 1/

1/ Includes 3 birds of 2 species seen off study areas but still on Nuclear Power Site (2 Red-tailed Hawks and 1 Say's Phoebe)

2/ Songs heard; birds not seen.

D

PRELIMINARY REPORT ON THE AQUATIC BIOTA BIOLOGICAL INVENTORY OF THE ST VRAIN NUCLEAR POWER SITE

C. A. Carlson

April 30, 1972

REPORT ON FT. ST. VRAIN

AQUATIC BIOTA BIOLOGICAL INVENTORY

A survey of the study area was conducted on April 13, 1972, to gain data prior to onset of high water levels and to acquaint new members of the aquatic biota inventory team with the area. A survey crew composed of Dr. William McConnell, Dr. Clarence Carlson, Dr. Paul Kugrens, Carl Schreck (Ph.D. candidate in fishery biology), Mark Johnson, three student volunteers, Mrs. Carlson, and a visiting aquatic scientist collected aquatic organisms at the study site. Collections of fishes, aquatic invertebrates, and algae were made at each of six stream stations identified as permanent sampling stations (see map attached). Water chemistry analyses were conducted, and air and water temperatures were measured at each station.

Fishes were collected by approximately 20 minutes of electrofishing in various habitats at each station. Collected fishes were weighed, total lengths were measured, and scales and stomachs were collected from representative sizes of each fish species for subsequent analysis. Carp (Cyprinus carpio), common shiners (Notropis cornutis), and white suckers (Catostomus commersoni) made up most of the fish collections. Fathead minnows (Pimephales promelas), longnose suckers (C. catostomus), and creek chubs (Semotilus atromaculatus) were also collected. Time has not yet permitted analysis of scale samples or stomach contents.

Aquatic macroinvertebrates were collected with nets and surber stream samplers from representative habitats at each station and preserved for subsequent identification. Invertebrates were surprisingly scarce. Those collected included tubificid worms (Oligochaeta), scuds (Crustacea),

chironomid fly larvae (Insecta), and dragonfly naiads (Insecta). Identification of macroinvertebrates is proceeding. Experimentation with techniques for mounting of chironomid larvae has delayed definitive progress on specific identifications.

Higher plants along the shorelines were primarily members of the mustard family. A long-tailed weasel (Mustela frenata) was encountered in stone "rip-rap" along the east shore just upstream from the pumping station on the St. Vrain River. A large unidentified snake and a snapping turtle (Chelydra serpentina)were encountered near the confluence of the St. Vrain and South Platte Rivers.

Fishes and invertebrates of Goosequill Pond were not sampled on April 13 because of extremely low water levels. Since Mr. Johnson has collected a sizeable backlog on fishes and invertebrates, supervising professors in fishery biology have opted to devote further efforts this spring to assisting him with identifications and analyses rather than returning to the study area to collect more of the same few organisms.

Algae in all areas sampled on April 13 were primarily Euglena agus and a variety of diatoms (in calm mud-bottomed areas) and Cladophora and Stigeoclonium (in swift water areas with rock substrates). The low diversity of algae encountered is considered indicative of a highly-polluted situation.

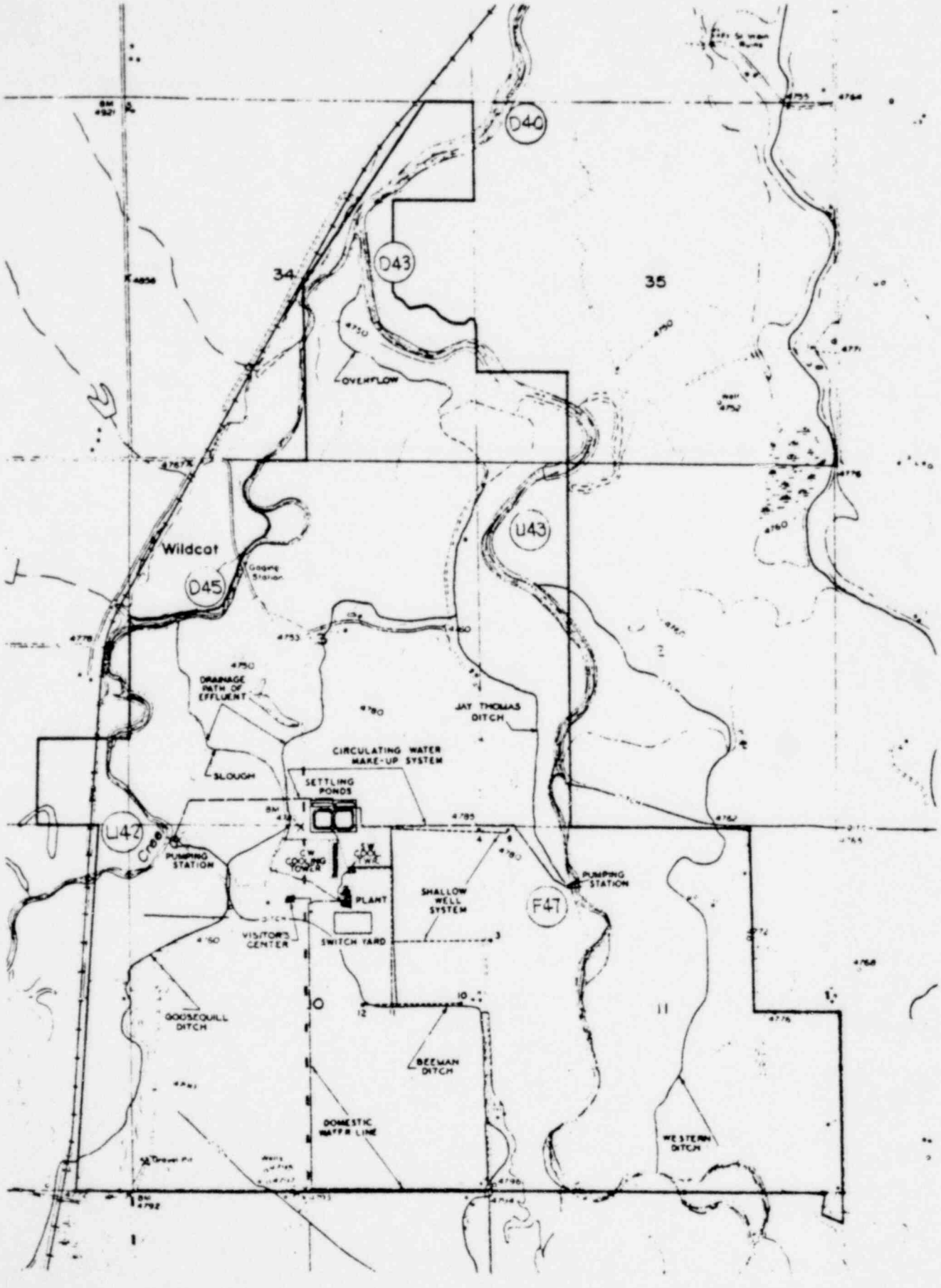

FIGURE D-1 - AQUATIC BIOTA SAMPLING STATIONS